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PRESENTATION 1.7

**N91 - 17027**

## **EXPLORATION INITIATIVES**

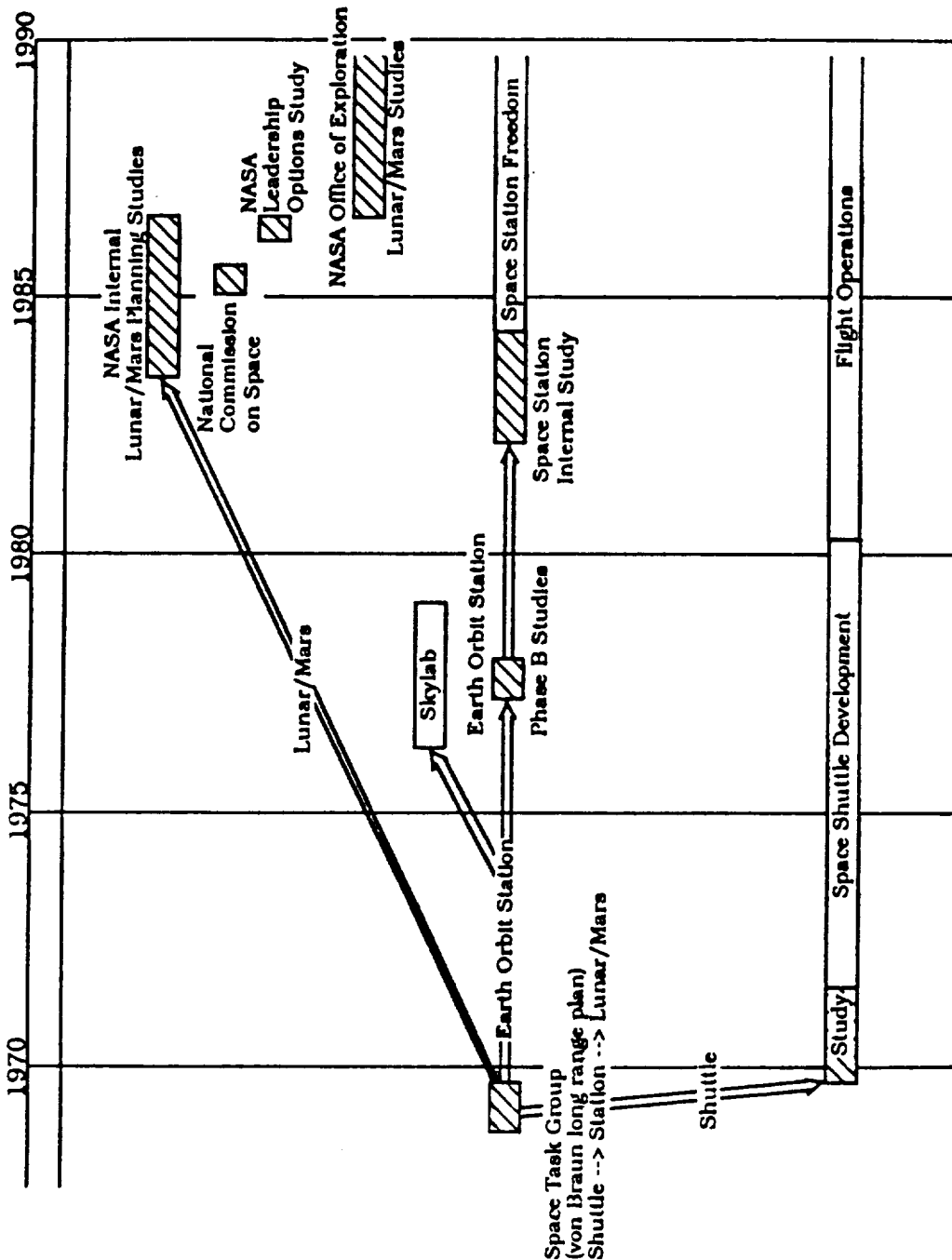






# NASA Exploration Initiative

## POST-APOLLO MANNED SPACEFLIGHT THRUSTS



Technical Study Group



## PRESIDENT BUSH

JULY 20, 1989

THE GOAL: "... TO ESTABLISH THE UNITED STATES AS THE PREEMINENT SPACE FARING  
NATION."

THE COMMITMENT: "... A SUSTAINED PROGRAM OF MANNED EXPLORATION OF THE SOLAR  
SYSTEM ... AND THE PERMANENT SETTLEMENT OF SPACE."

THE PLAN: "FIRST ... FOR THE 1990'S ... SPACE STATION FREEDOM ..

AND NEXT - FOR THE NEW CENTURY - BACK TO THE MOON.  
AND THIS TIME BACK TO STAY.

AND THEN - A JOURNEY TO ANOTHER PLANET - A MANNED MISSION TO MARS.

EACH MISSION ... WILL LAY THE GROUNDWORK FOR THE NEXT."

THE ACTION: "... VICE PRESIDENT ... TO LEAD THE NATIONAL SPACE COUNCIL IN  
DETERMINING SPECIFICALLY WHAT'S NEEDED ...

- MONEY, MANPOWER, AND MATERIAL ...
- FEASIBILITY OF INTERNATIONAL COOPERATION ...
- REALISTIC TIMETABLES, MILESTONES ...

... REPORT BACK AS SOON AS POSSIBLE WITH CONCRETE RECOMMENDATIONS"





## PRE-JULY 20, 1989 STUDIES

### PATHWAYS

- Moon only-science
- Moon only-oasis
- Mars only
- Phobos --> Mars
- Moon --> Mars

### MAJOR VARIABLES EXAMINED

- Launch vehicle size vs. in-space assembly vs. direct to surface
- SSF vs. new spacecraft vs. direct assembly
- Spaceport in lunar orbit
- Various Mars trajectories: sprint, split/sprint, opposition, conjunction, Venus assist
- Chemical vs. electric vs. nuclear vs. unconventional propulsion
- Aerobraking vs. all-propulsive vehicles
- Expeditions vs. evolution
- Expendable vs. reusable spacecraft
- Propellant transfer vs. tank transfer
- Open vs. closed life support
- Zero-g vs. artificial-g Mars vehicle
- In-situ resources vs. Earth-supplied

## POST-JULY 20, 1989

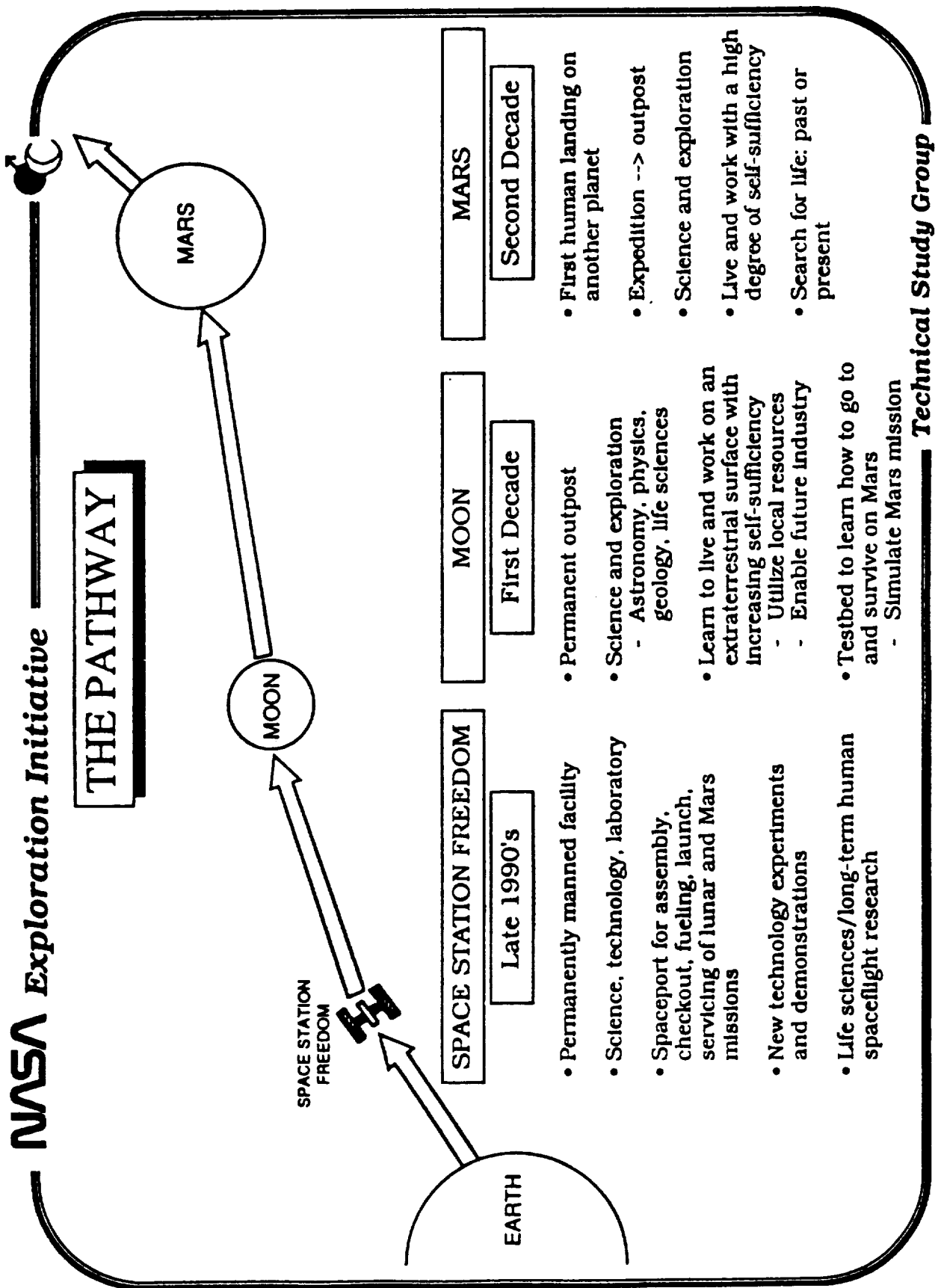
### PATHWAY SET:

- SSF --> Moon --> Mars

### MAJOR QUESTIONS

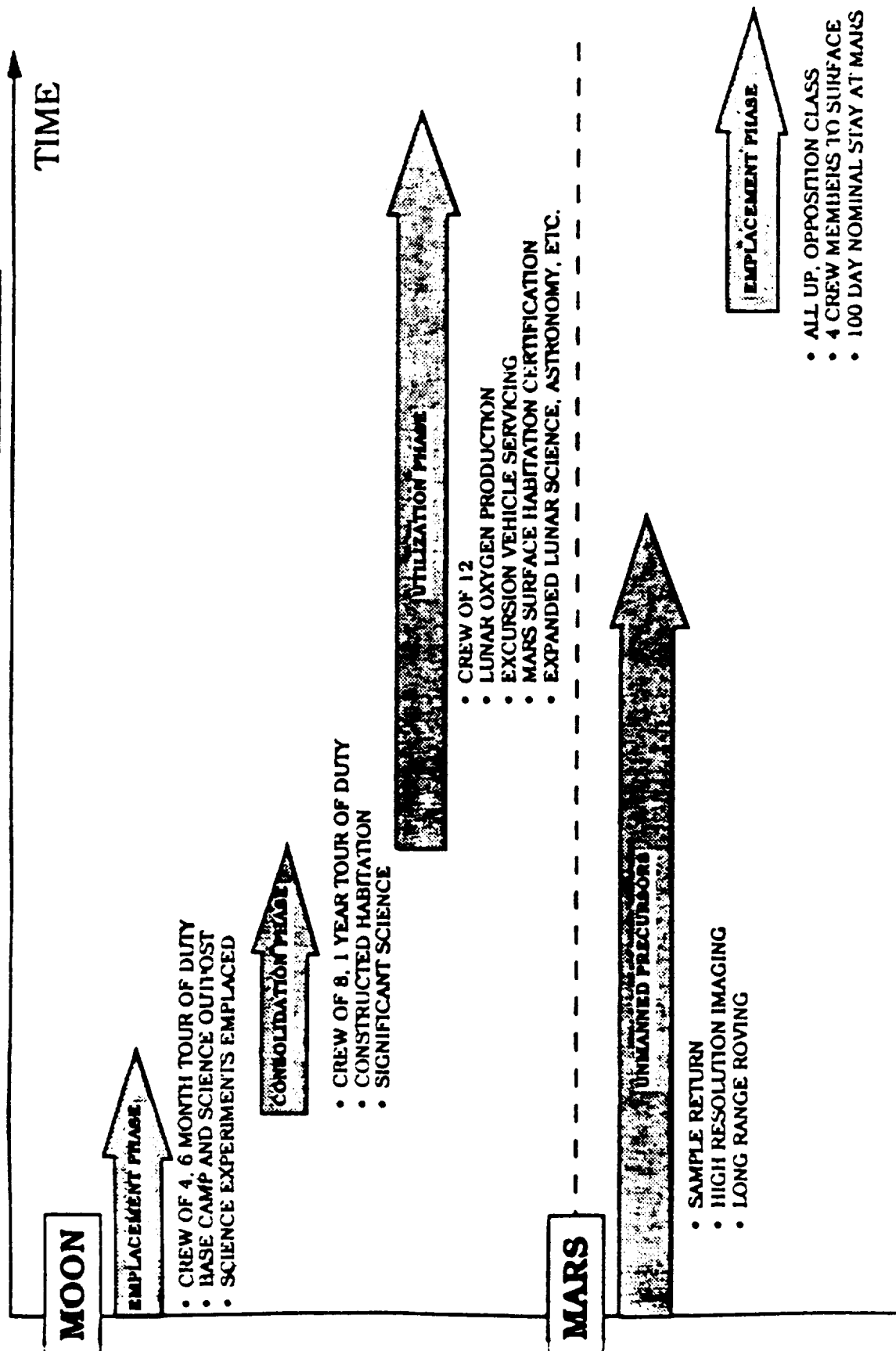
- Scale of program
- Program schedule
- Lunar emphasis
- Technology level
- Cost







# A POSSIBLE MISSION SCENARIO BASED ON EVOLUTIONARY APPROACH

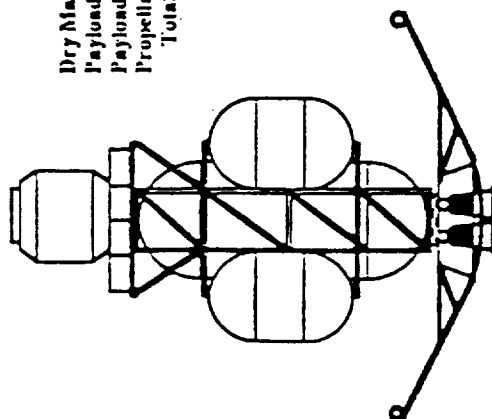




# LUNAR TRANSPORTATION VEHICLES 2003 - 2005

## LUNAR TRANSFER VEHICLE

Dry Mass	18.7
Payload Out	54.8*
Payload Back	(1.2)
Propellant	146.6
Total Wet Mass	220.1

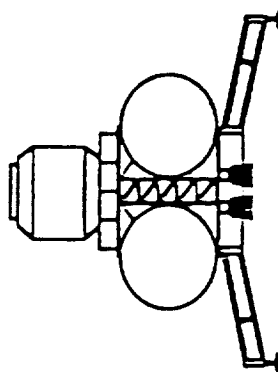


**Engines:**  
Type : RS-44 Class  
Thrust: 133.4 KN  
Isp: 481 secs.  
Number: 3

### PILOTED CONFIGURATION

## LUNAR EXCURSION VEHICLE

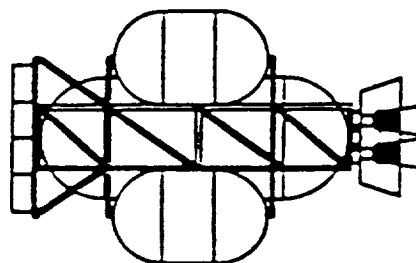
Dry Mass	6.3
Payload Down	23.7
Payload Up	(1.2)
Propellant	24.8
Total Wet Mass	54.8



**Engines:**  
Type : RS-44 Class  
Thrust: 266.9 KN  
Isp: 465 secs.  
Number: 4

### PILOTED CONFIGURATION

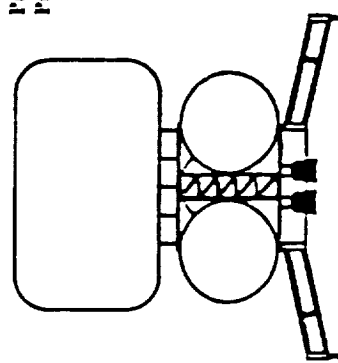
Dry Mass	7.8
Payload Out	64.6*
Payload Back	(0.0)
Propellant	124.1
Total Wet Mass	196.5



**Engines:**  
Type : RS-44 Class  
Thrust: 133.4 KN  
Isp: 481 secs.  
Number: 3

### CARGO CONFIGURATION

Dry Mass	3.4
Payload Down	37.0
Payload Up	(0.0)
Propellant	24.2
Total Wet Mass	64.6



**Engines:**  
Type : RS-44 Class  
Thrust: 266.9 KN  
Isp: 465 secs.  
Number: 4

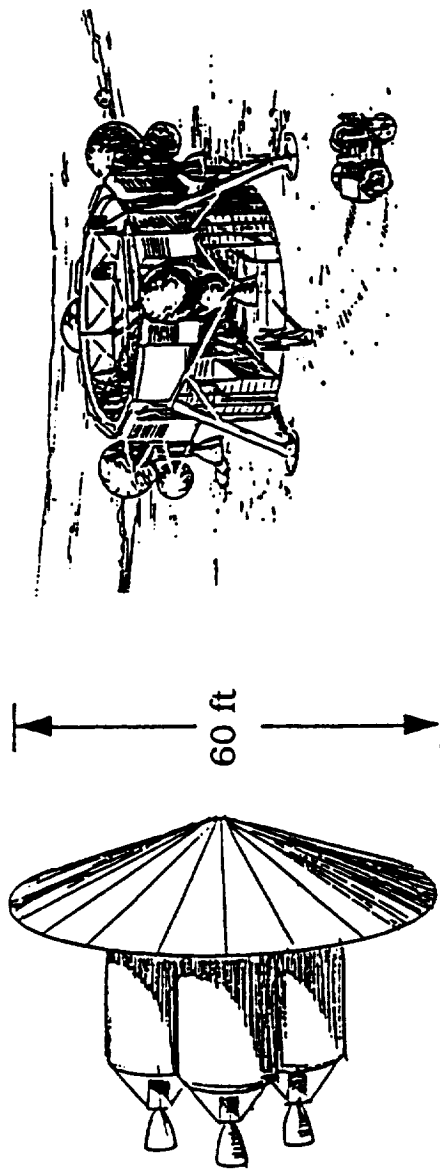
### CARGO CONFIGURATION

\* Payload out includes wet excursion vehicle and payload

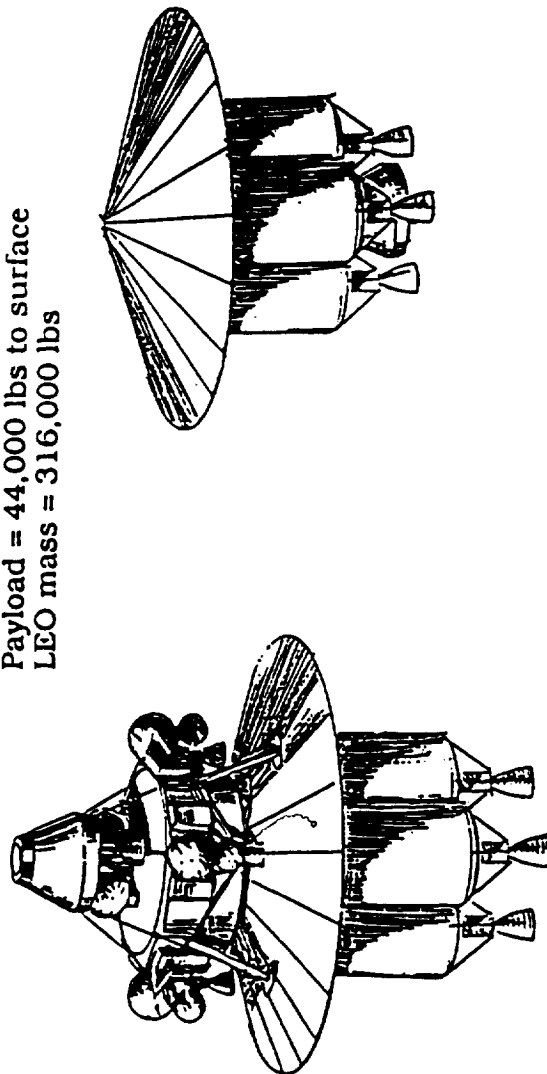




## LUNAR TRANSFER, DESCENT, AND ASCENT VEHICLES



Payload = 44,000 lbs to surface  
LEO mass = 316,000 lbs



Office of Exploration



# Surface Systems Function Areas

**Surface Transportation**  
Rovers:  
Pressurized,  
Unpressurized,  
Unmanned

**ISRU**  
Mining, Propellants,  
Building Materials

**Energy**  
Generation,  
Distribution,  
Conversion

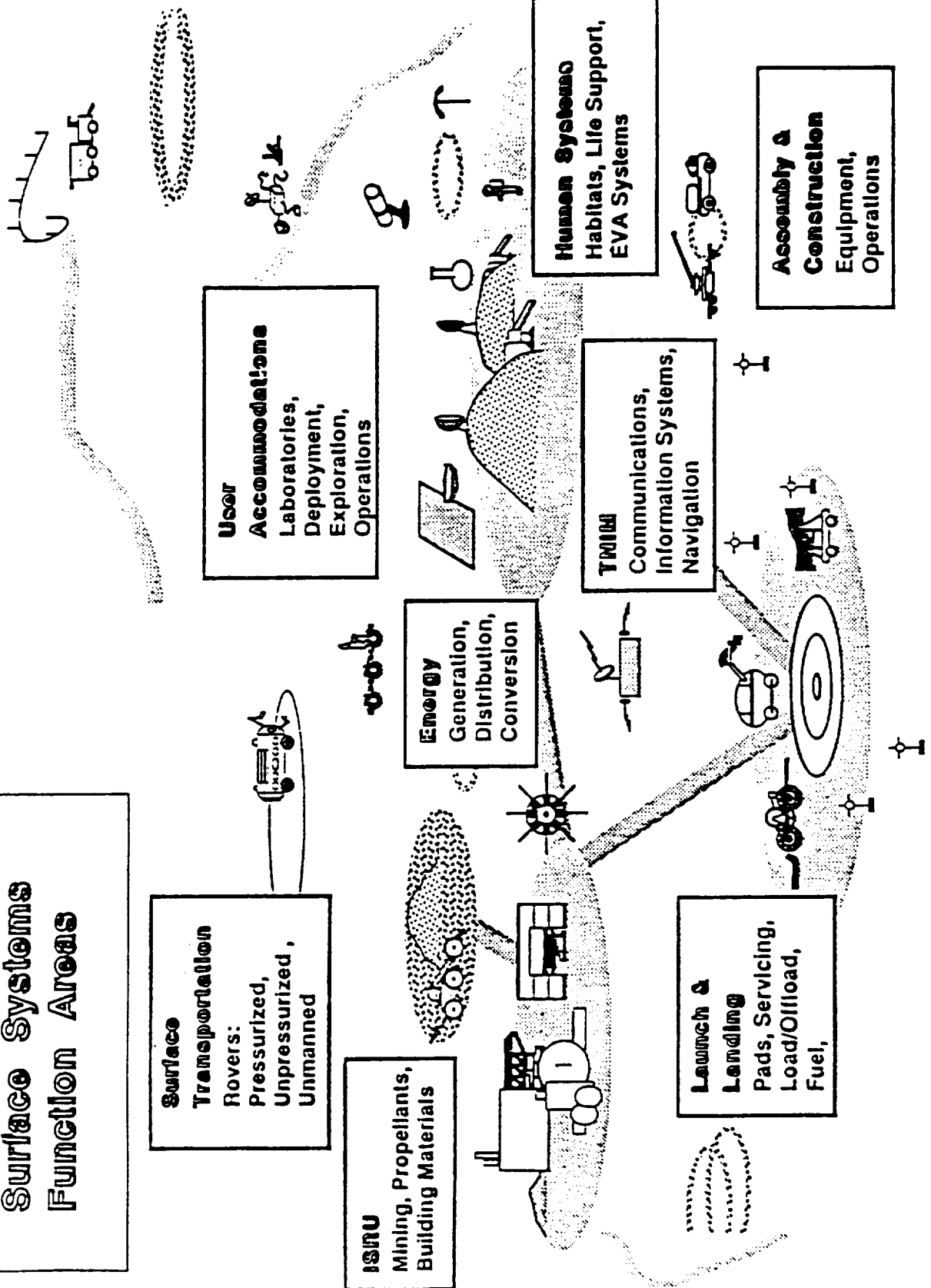
**User Accommodations**  
Laboratories,  
Deployment,  
Exploration,  
Operations

**Human Systems**  
Habitats, Life Support,  
EVA Systems

**Assembly & Construction**  
Equipment,  
Operations

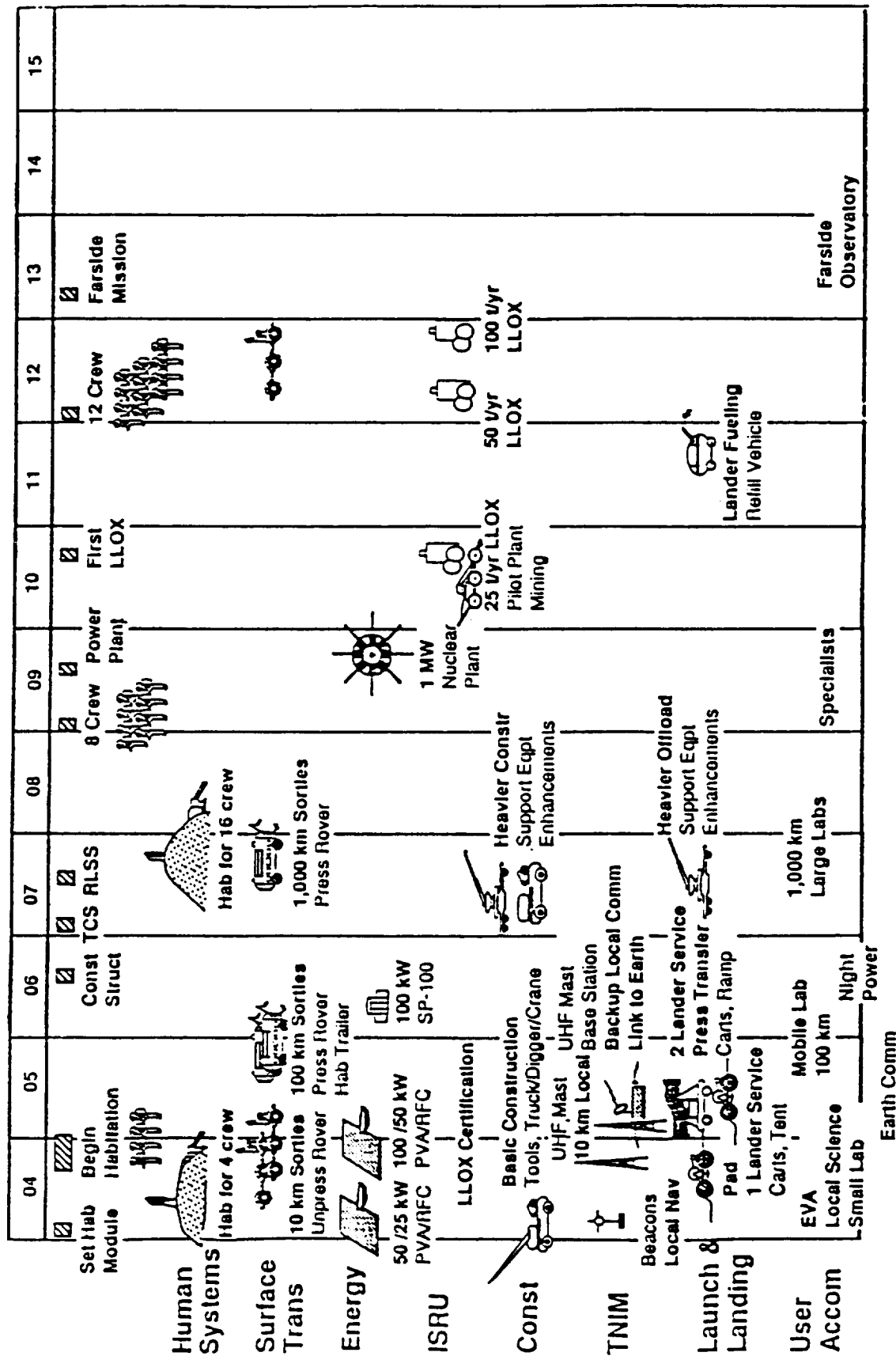
**TMIR**  
Communications,  
Information Systems,  
Navigation

**Launch & Landing**  
Pads, Servicing,  
Load/Offload,  
Fuel,



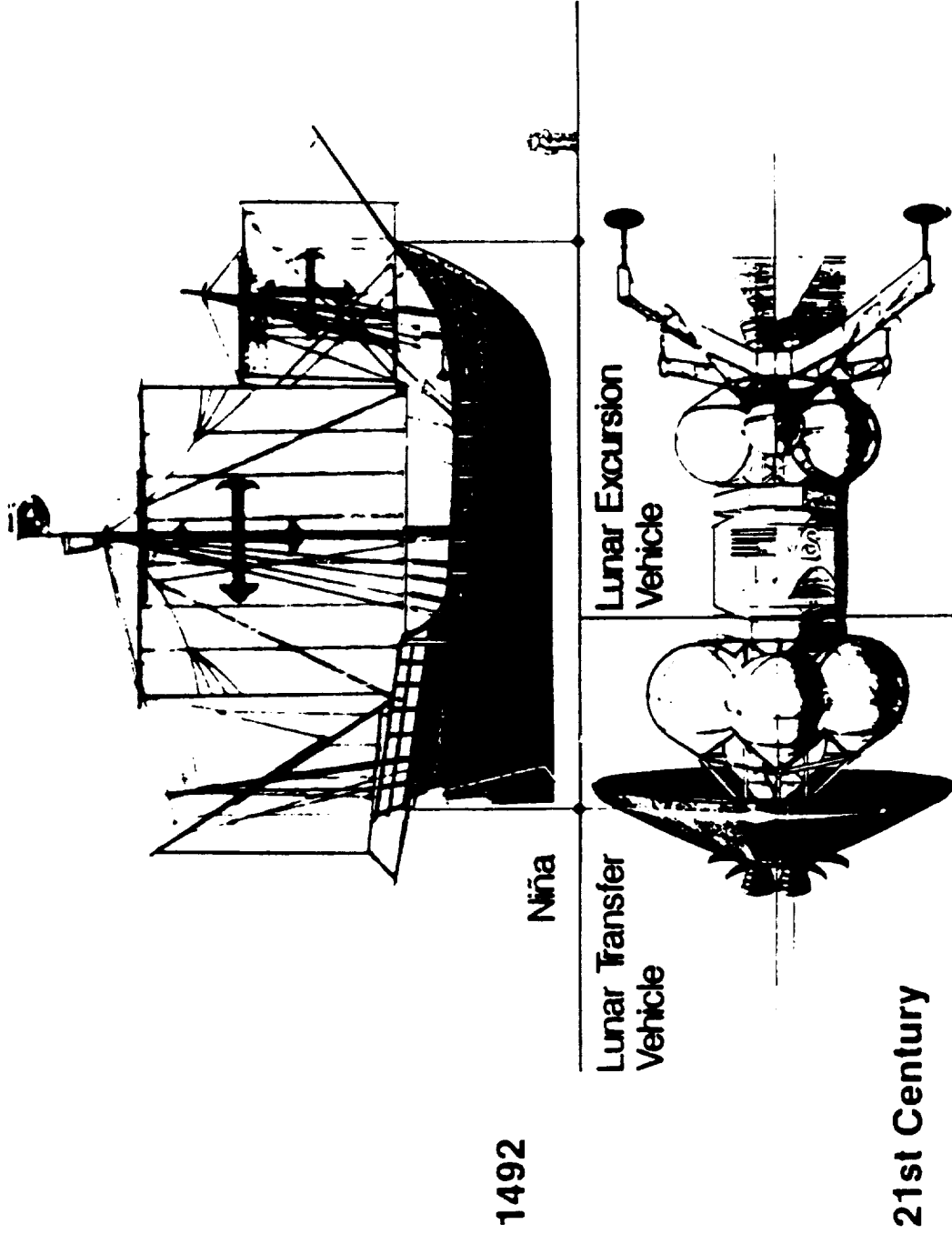


# Lunar Evolution Summary



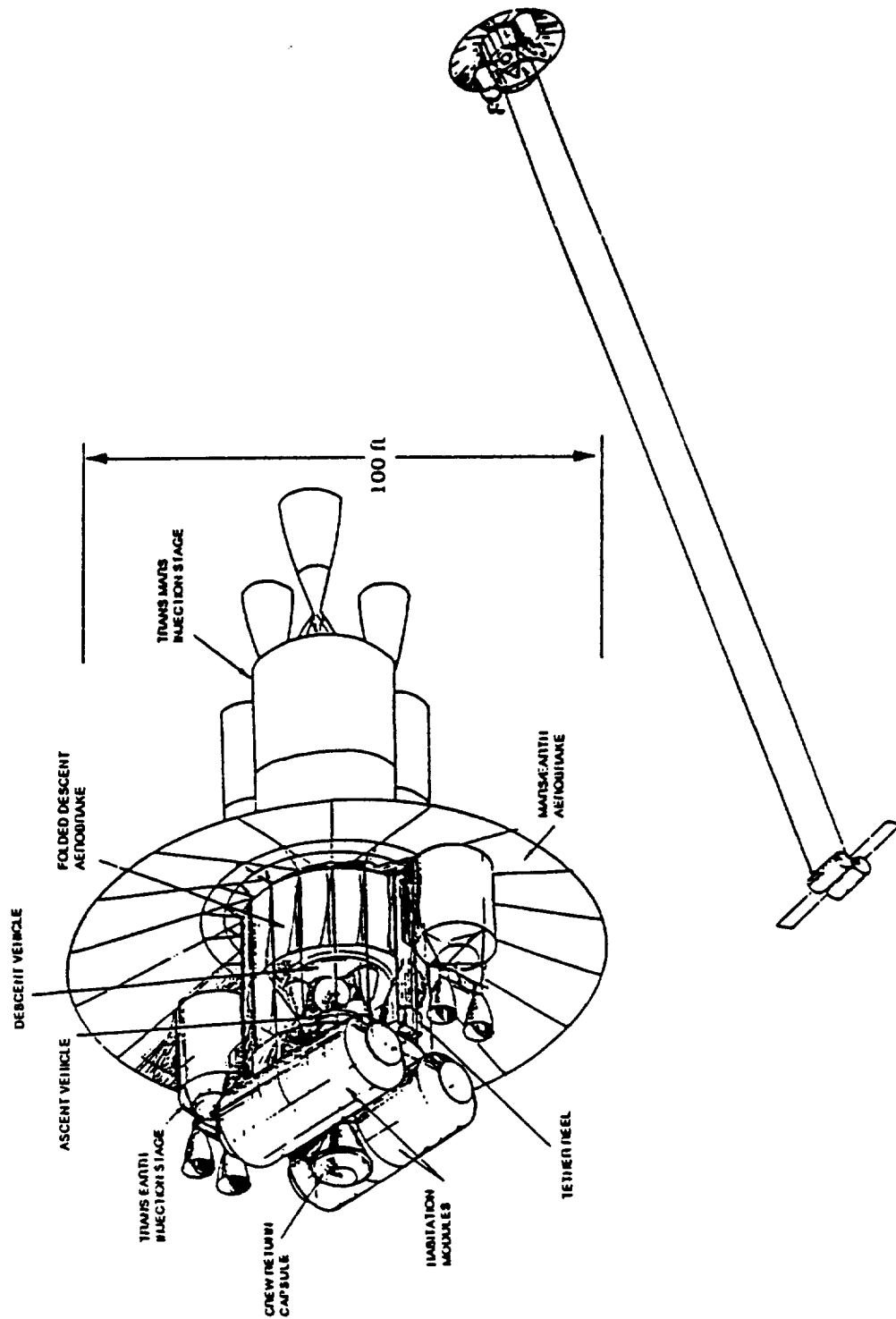


# **Ships of Exploration**



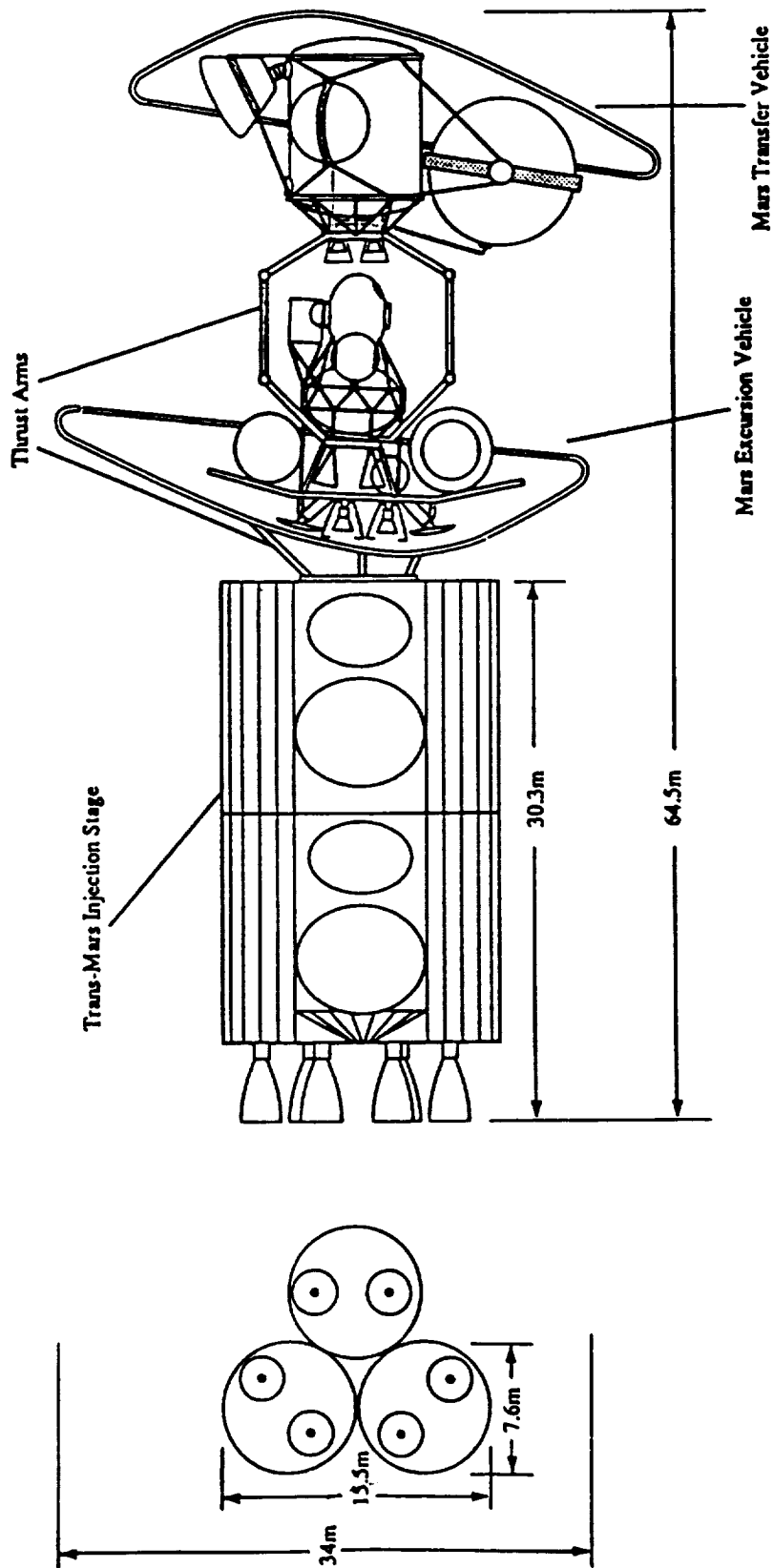


# MARS SPACECRAFT





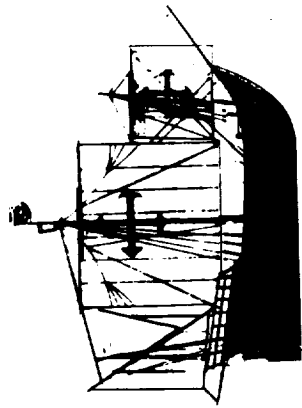
# Full-up Mars Mission Vehicle in LEO



MTV	203.7t
MEV	81.6t
TMIS	526.4t
<hr/>	
Total IMEO	811.7t



# **Ships of Exploration**



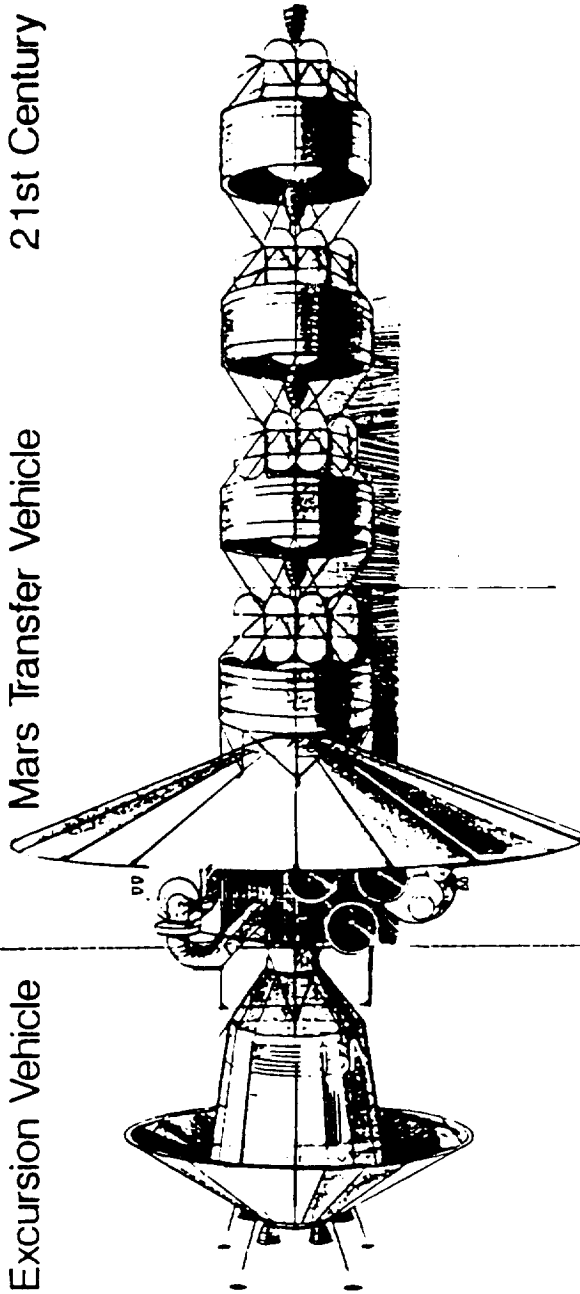
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Mars Excursion Vehicle

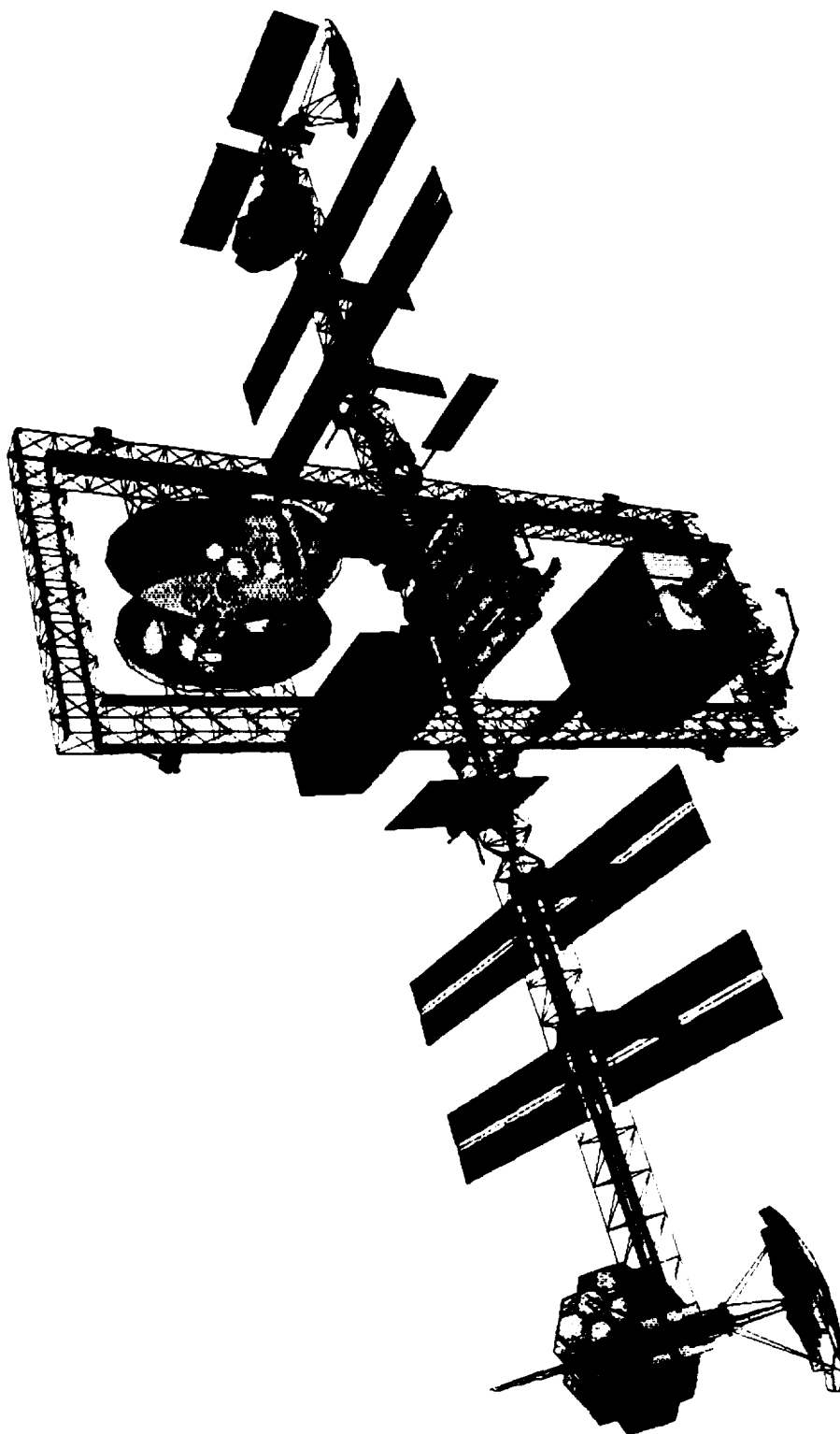
Mars Transfer Vehicle

21st Century





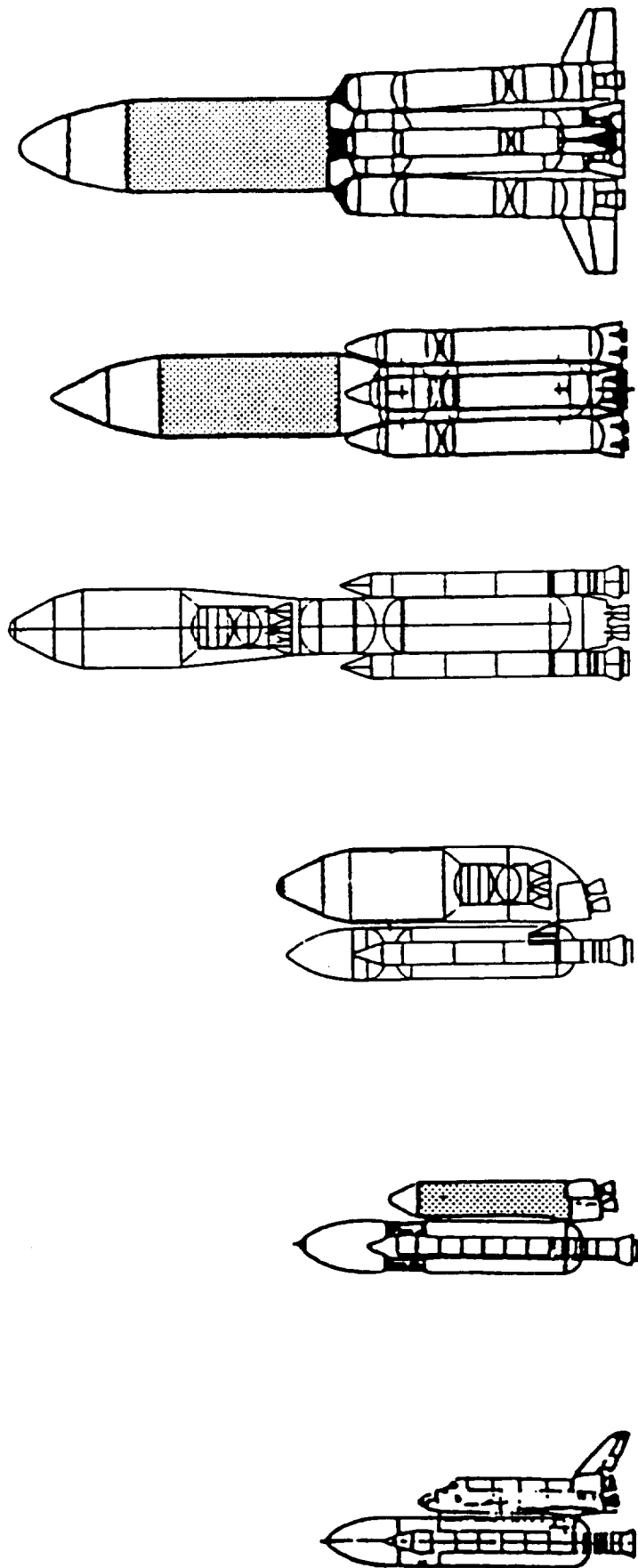
# LUNAR/MARS TRANSPORTATION NODE



*LaRC SSFO*



# SHUTTLE - DERIVED LAUNCH VEHICLES



STS

SHUTTLE C

SHUTTLE Z

SHUTTLE - DERIVED VEHICLES

SIDEMOUNT

SIDEMOUNT

INLINE

INLINE

THIRD STAGE

LIQUID STRAPONS

LIQUID STRAPONS

MORE ASRMs

BIGGER CORE



# **Lunar/Mars Space Transportation Systems Technology/Advanced Development**

- Most Critical Areas of Technology/Advanced Development

## **Lunar**

- Aerobrake
- Space Transfer Engine
- Cryogenic Storage and Transfer
- Cryogenic Aux. Propulsion

## **Mars**

- Lightweight Aerobreakes
- Cryogenic Storage Transfer
- On-Orbit Assy & Veh Process.
- Space Transfer/Landing Engines
- ECLSS for Long-Duration Missions
- Alternate Propulsion Technology
- Nuclear Thermal/Solar Electric